

Decadal Variability Update

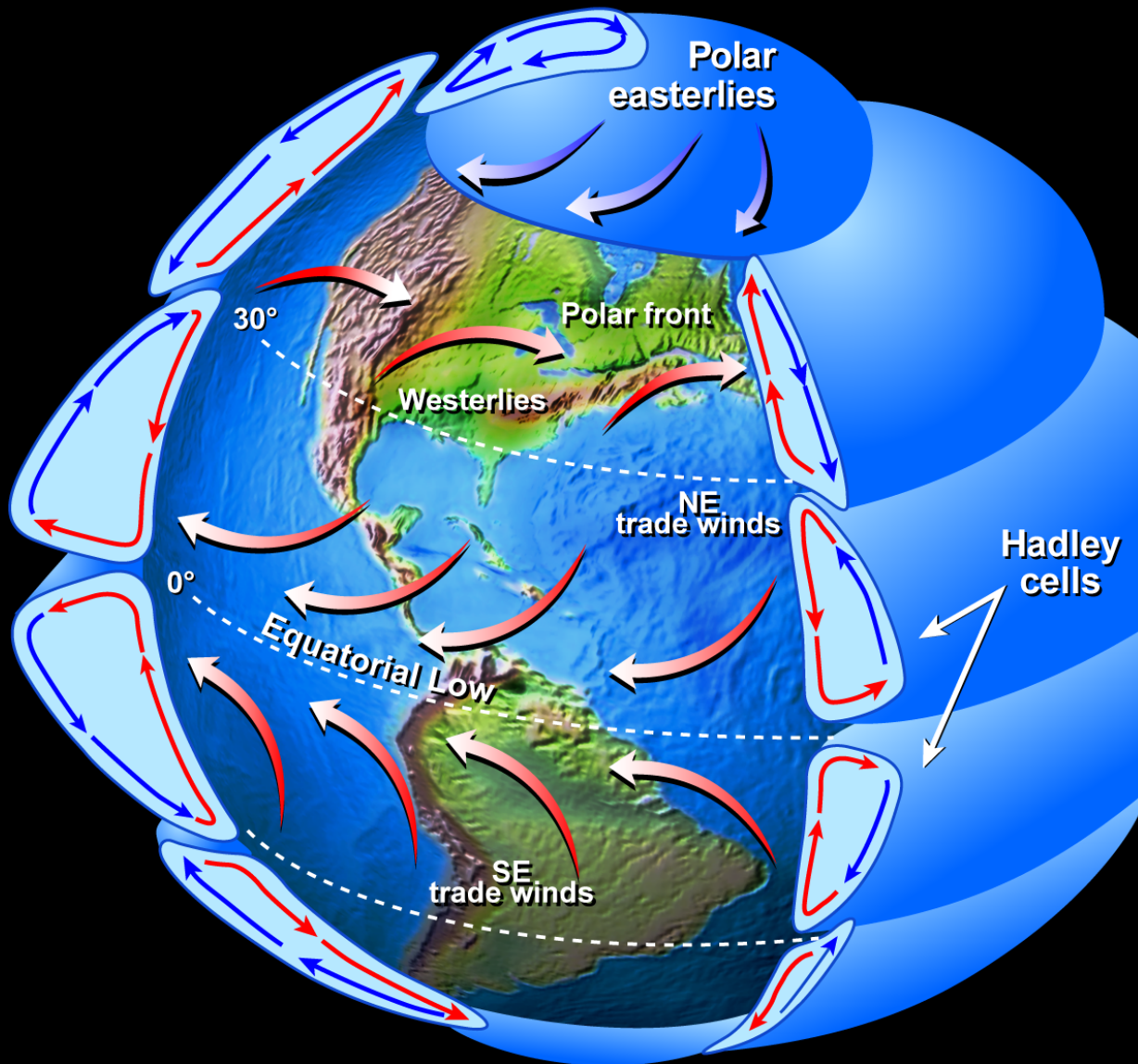
***Wielicki, Wong
Del Genio, Chen, Carlson, Rossow
Allan, Slingo,
Robertson,
Yang, Miller, Jacobowitz,
Gordon, Soden,
Susskind,
Randall,***

(Others as noted)

***LaRC
GISS
UKMO
MSFC
NOAA
GFDL
GSFC
CSU***

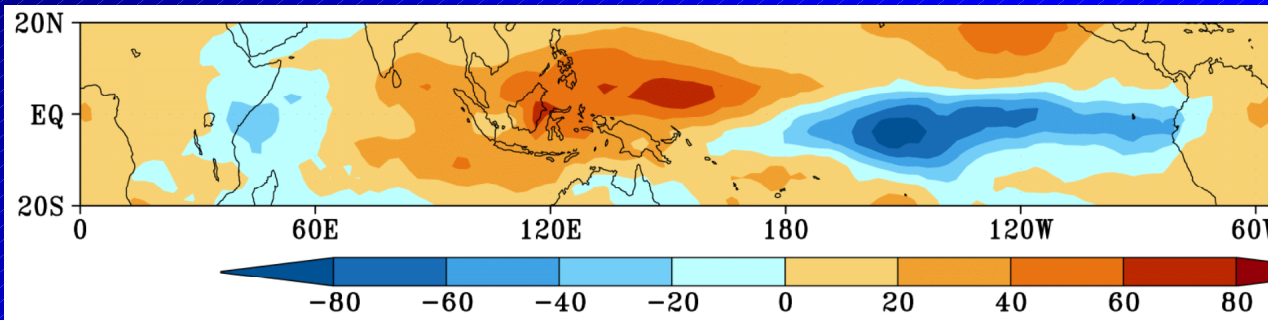
CERES ST Meeting, May 14, 2002

Global Atmospheric Circulation

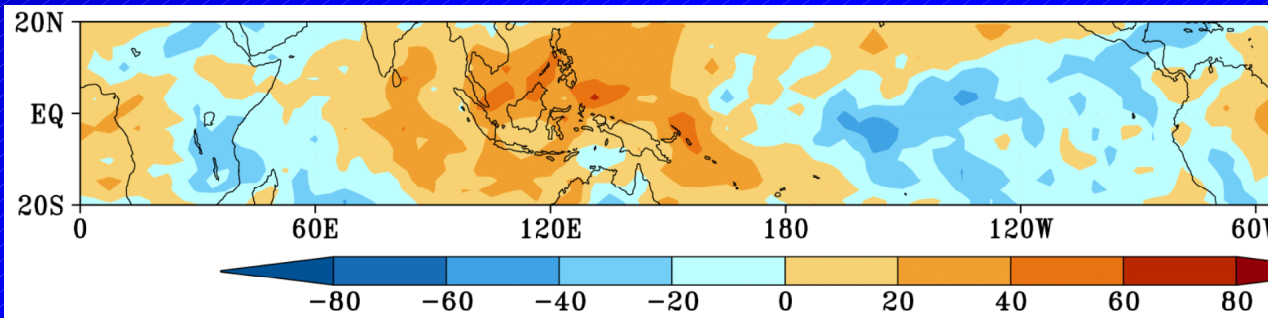


Jan/Feb 98 El Nino Thermal Flux Anomalies

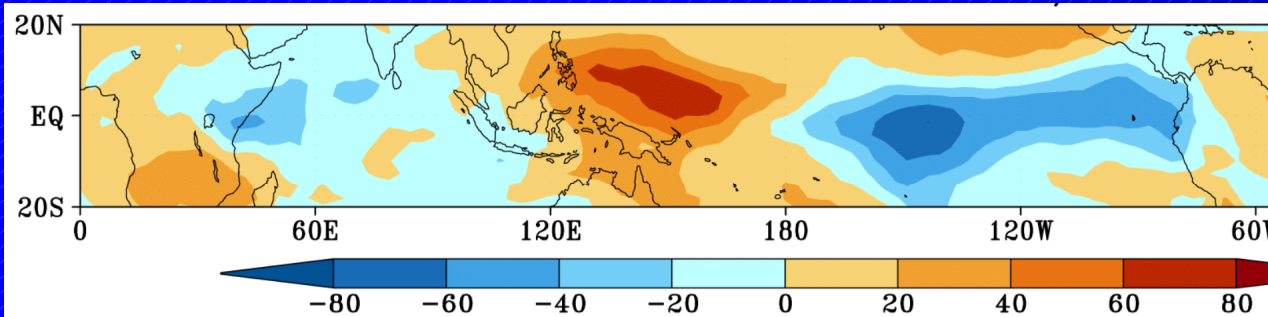
NASA CERES Radiation Observations



NOAA GFDL Standard Climate Model

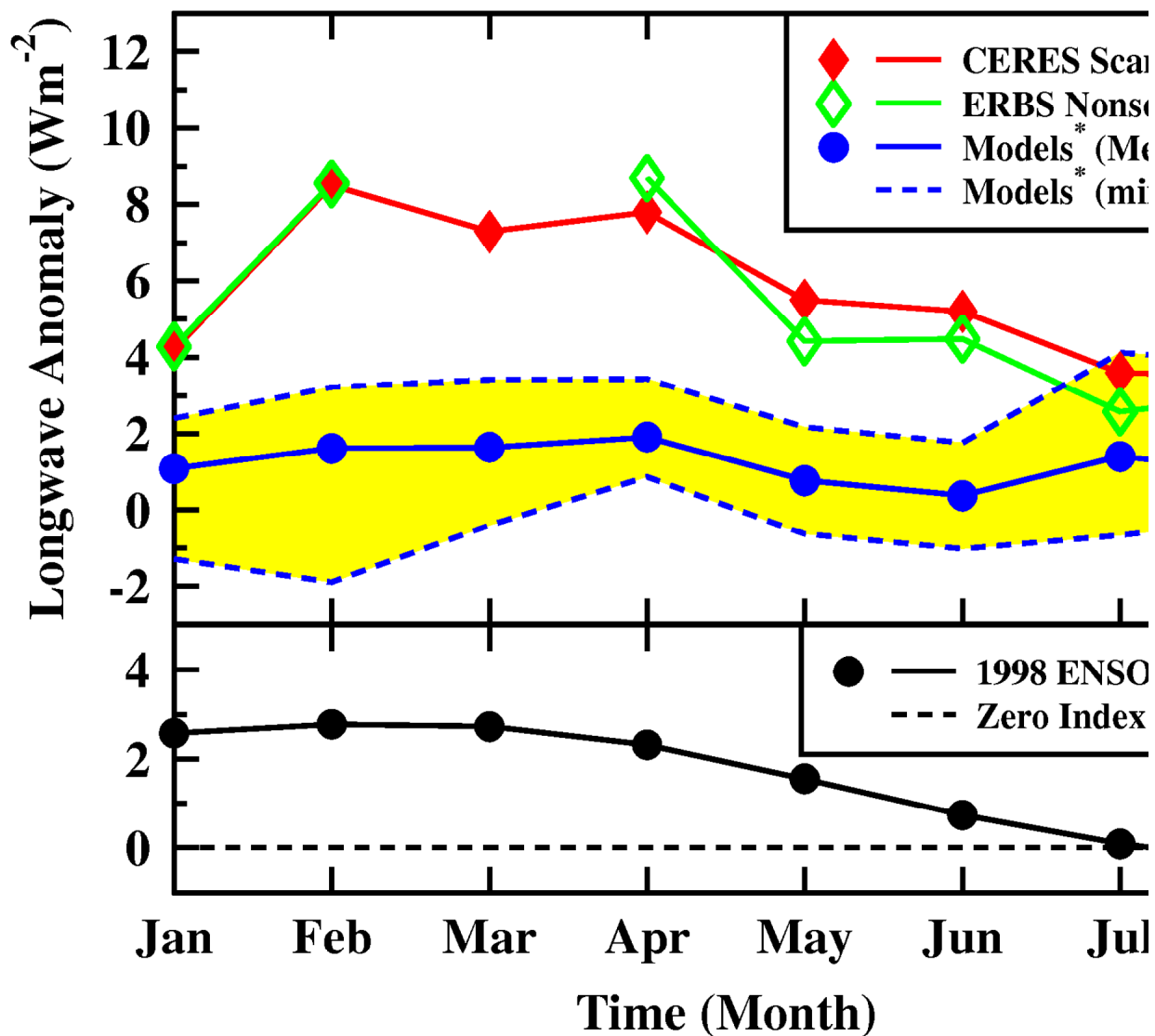


NOAA GFDL Experimental Prediction Model



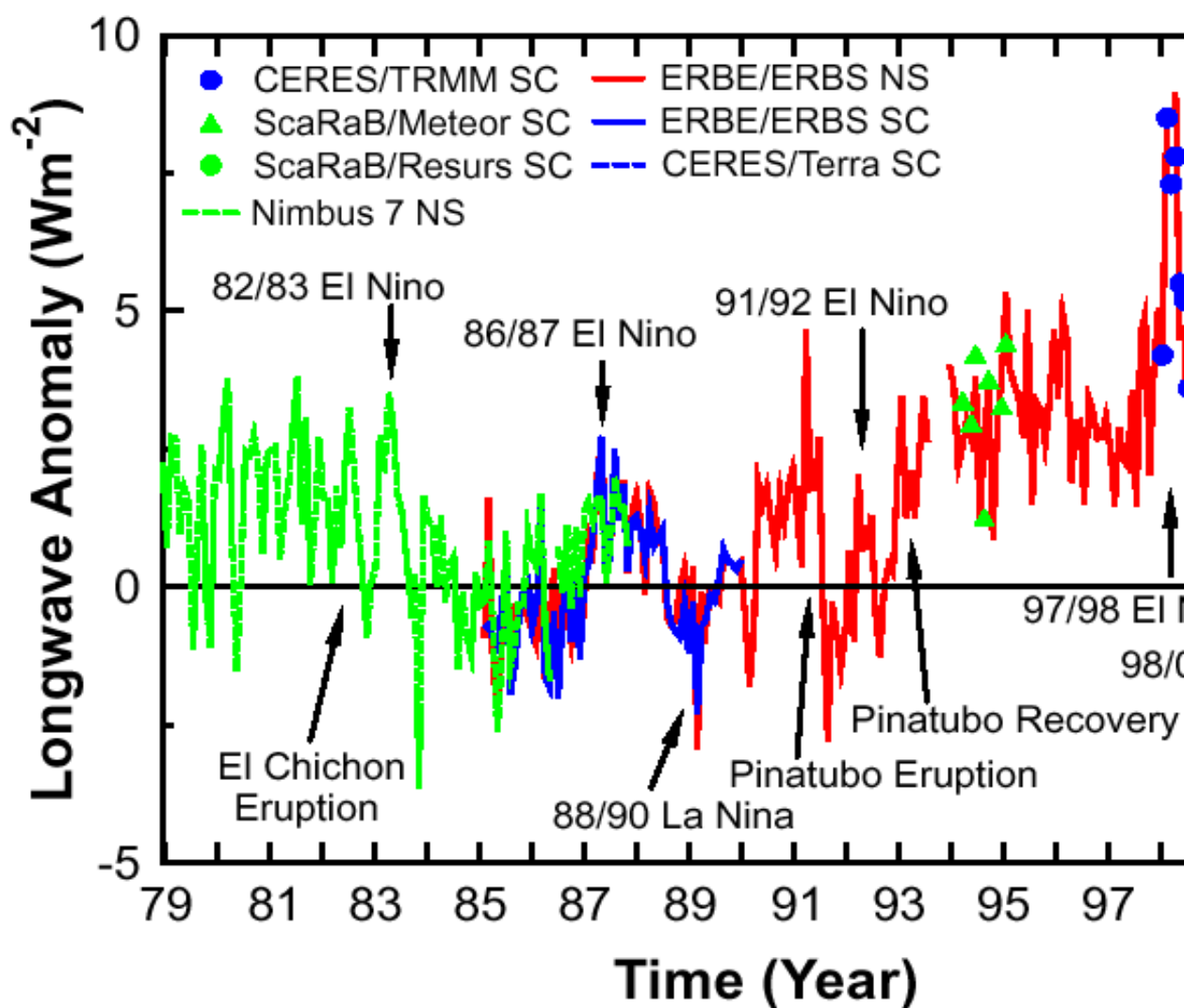
1998 El Nino Tropical Mean (20S - 20N) Longwave Flux

(Anomalies Referenced to 1985 through 1989 Baseline)



Climate Models and NCEP Re-analysis; All used observed SSTs; Climate Models KMO (Allan, Slingo), GFDL and GFDL-EP (Soden, Gordon), CSU (Randall)

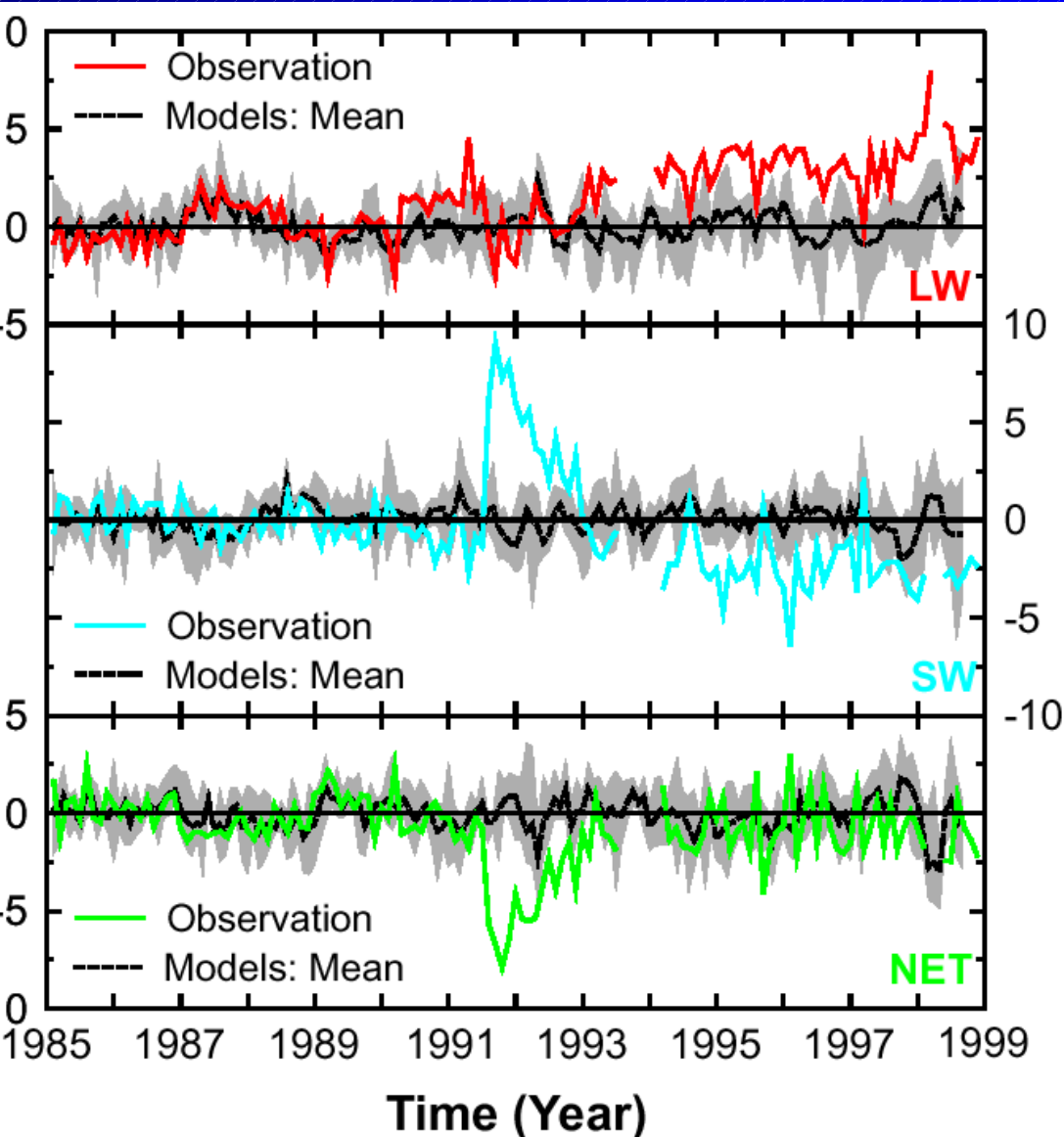
An overlapping Earth radiation climate record 22 years from Nimbus 7 to Terra.



Trenberth Letter to Science/Response

- **Trenberth concerns:**
 - a) 3 month ERBS gap caused 3 W/m² shift in LW
 - b) Diurnal aliasing causing seasonal cycle change in 90s versus 80s
- **Response (both accepted by Science)**
 - a) No: offset changes expected for cavities and no change relative to HIRS/AVHRR. Also fails to explain SW changes.
 - b) Yes: 36-day precession cycle means instead of 30 day months removed 2/3 of seasonal cycle change in SW, emphasized decadal signal, some variability remains.
- **Both: need stronger emphasis on redundant high accuracy calibrated overlapped climate data sets: e.g. broadband and spectral LW flux.**

Comparison of Observed Decadal Tropical Radiation Variation with Current Climate Models



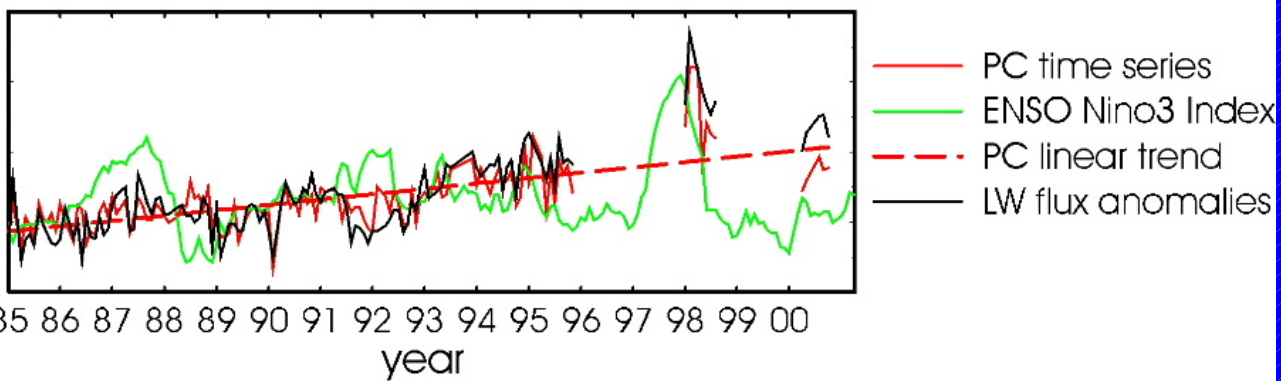
LW:
Emitted Thermal
Fluxes

SW:
Reflected Solar
Fluxes

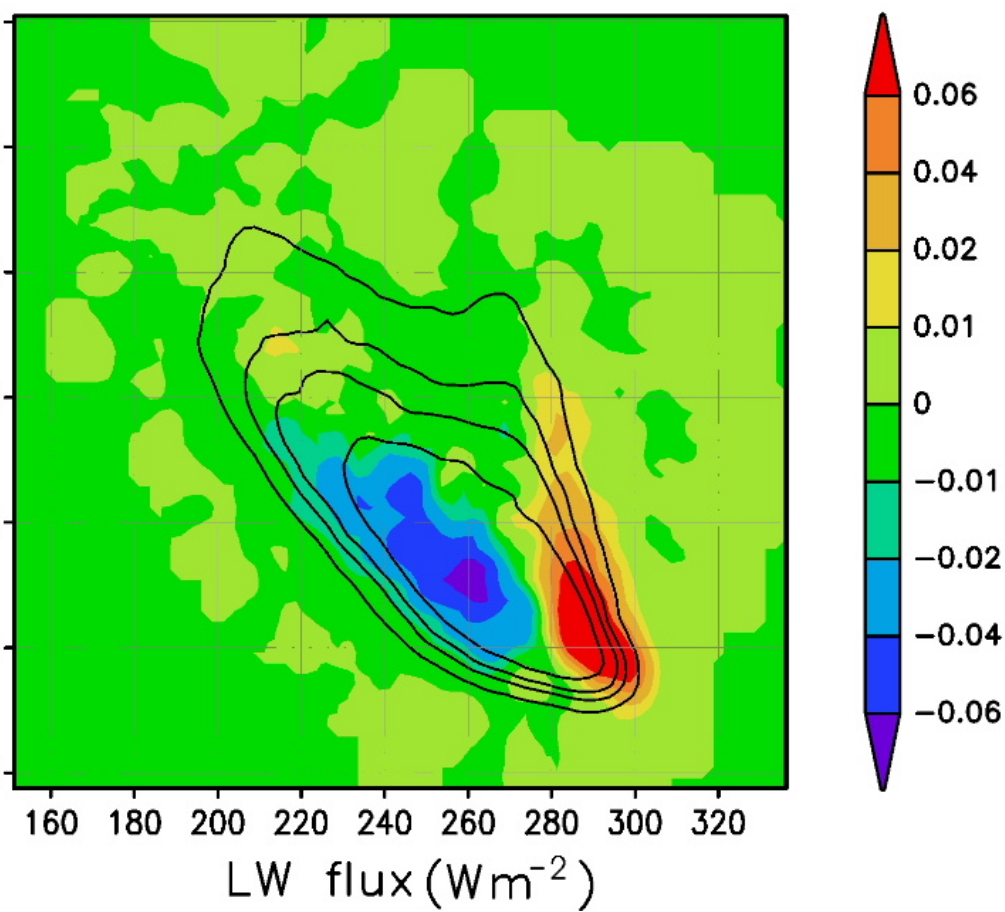
Net:
Net Radiative Fluxes

*Models less variable
than the observations*
- *missing feedbacks?*
- *missing forcings?*
- *clouds physics?*

A



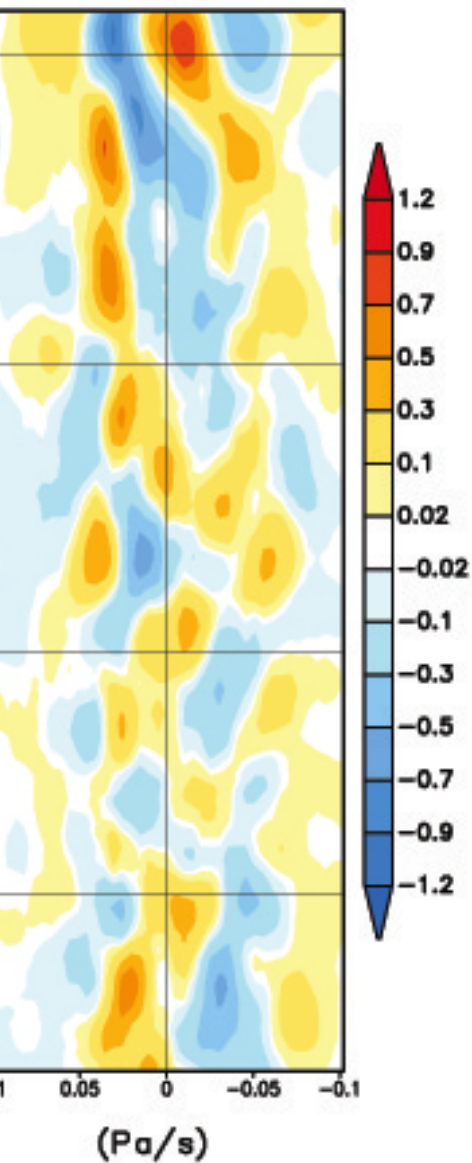
B



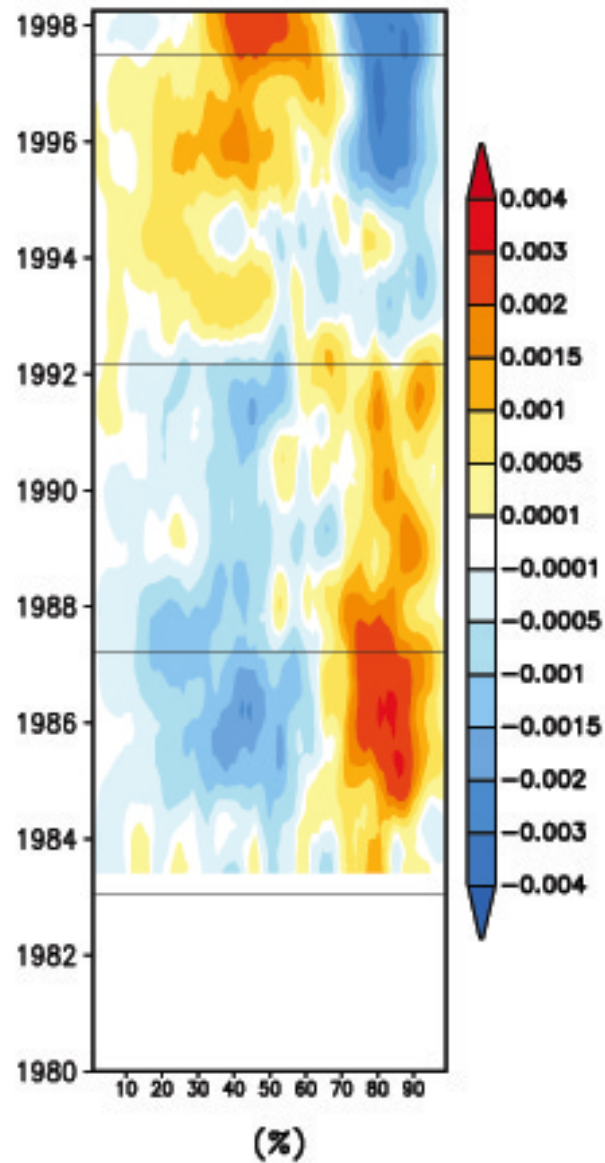
Chen et al. Science
Feb, 2002

Frequency Density Distribution Anomaly Time Series in S30

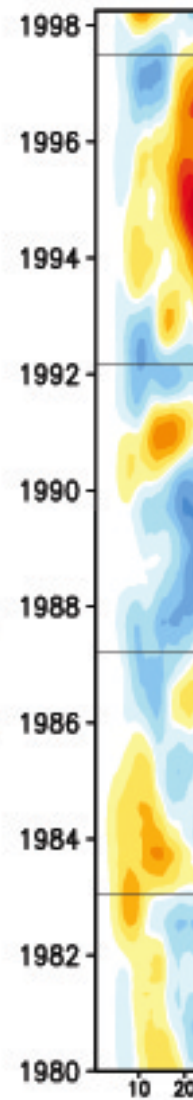
CEP: 500hPa Omega



ISCCP Cloud Amount



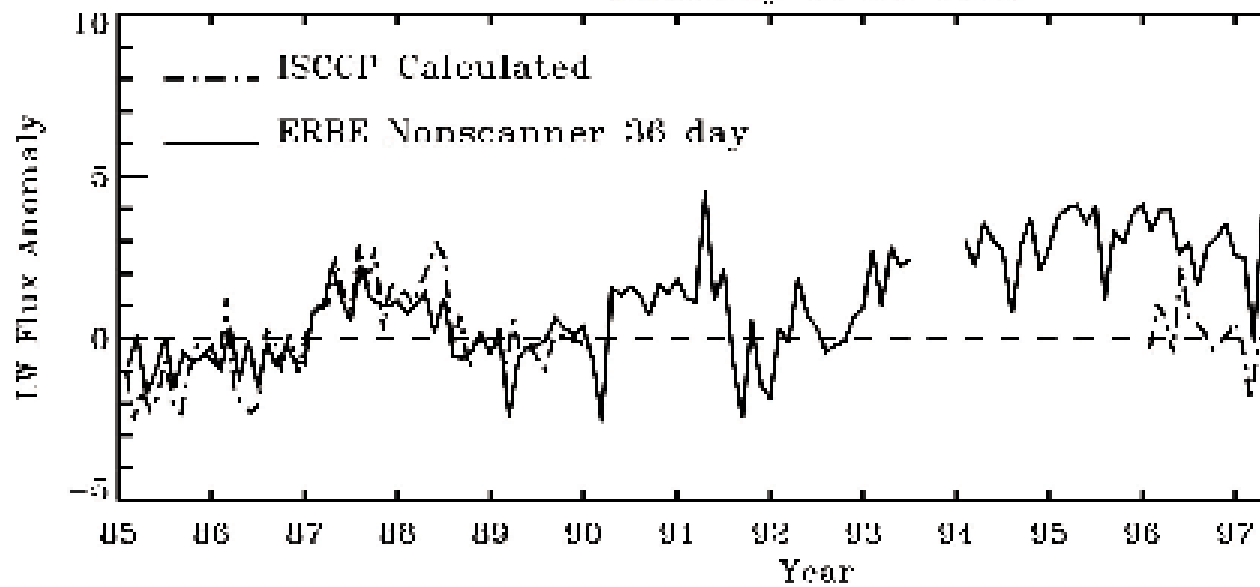
Bates: HIRS UTH



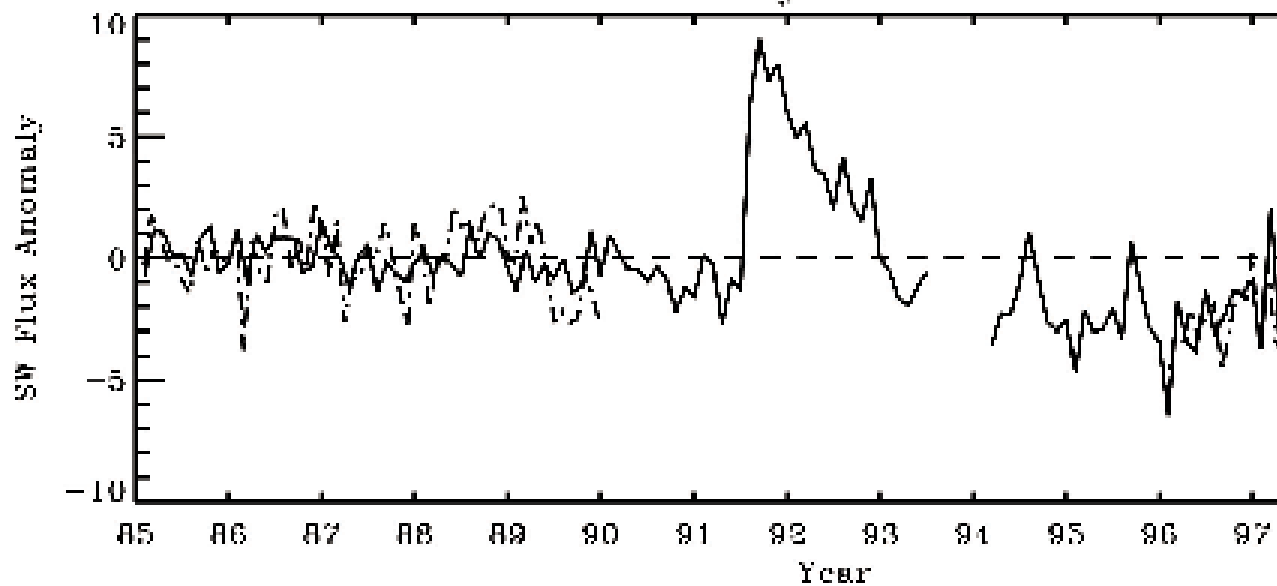
Chen, Del Genio, Carlson, NASA

Essow/Carlson: ISCCP + Rad Model => TOA flux anomaly

Anomaly of LW Flux

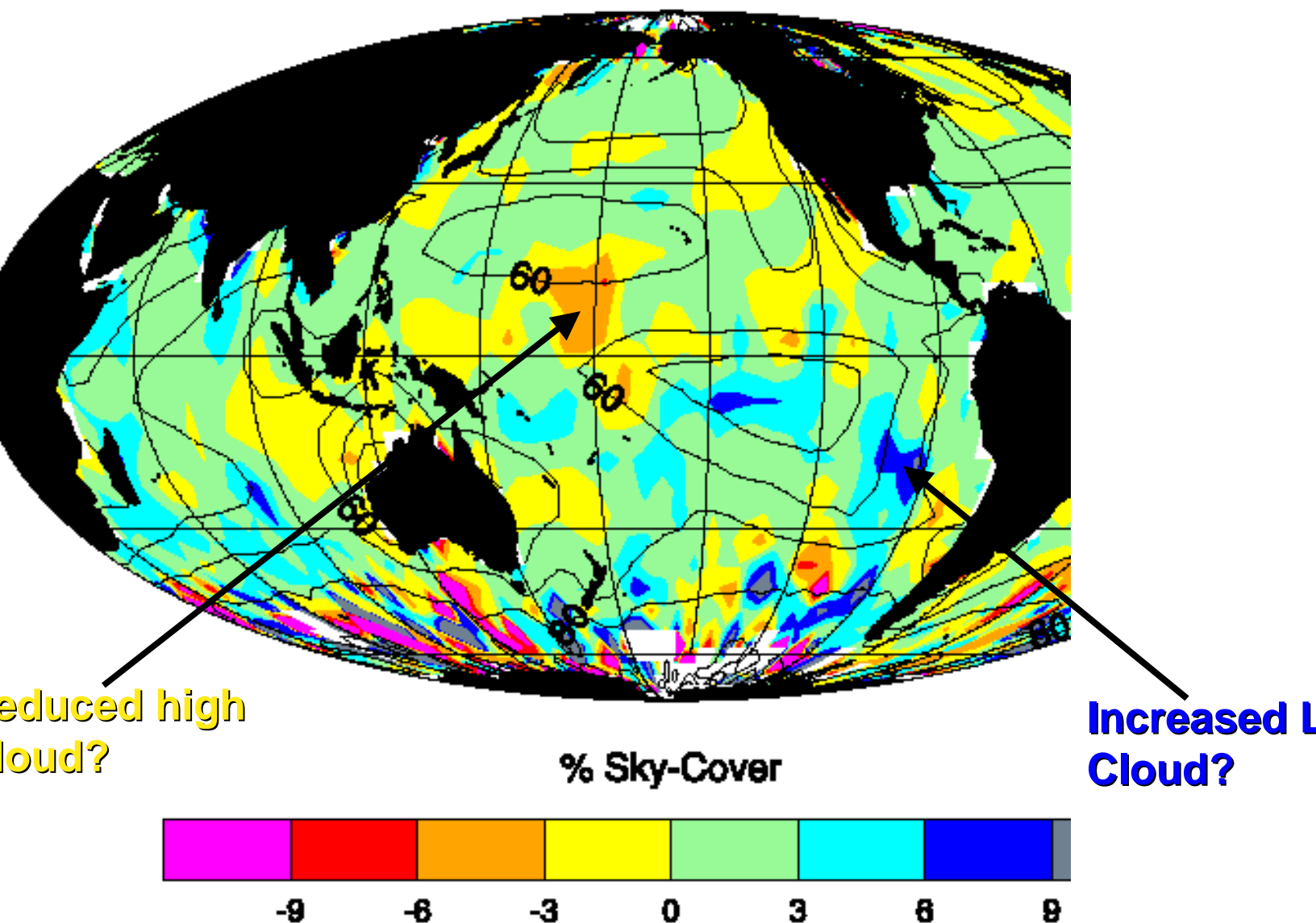


Anomaly of SW Flux

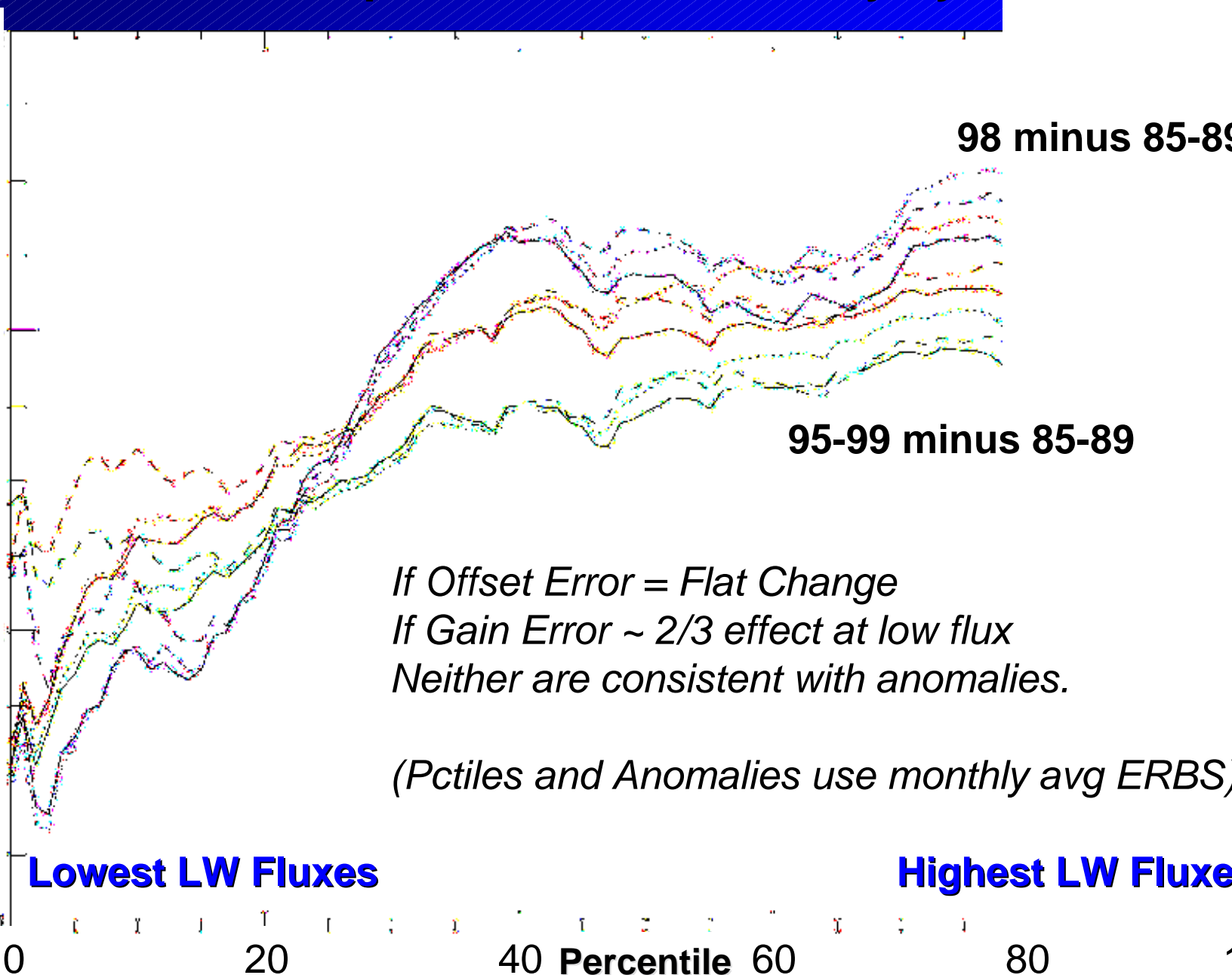


de Norris, Scripps: Surface Observer Total Cloud Amount

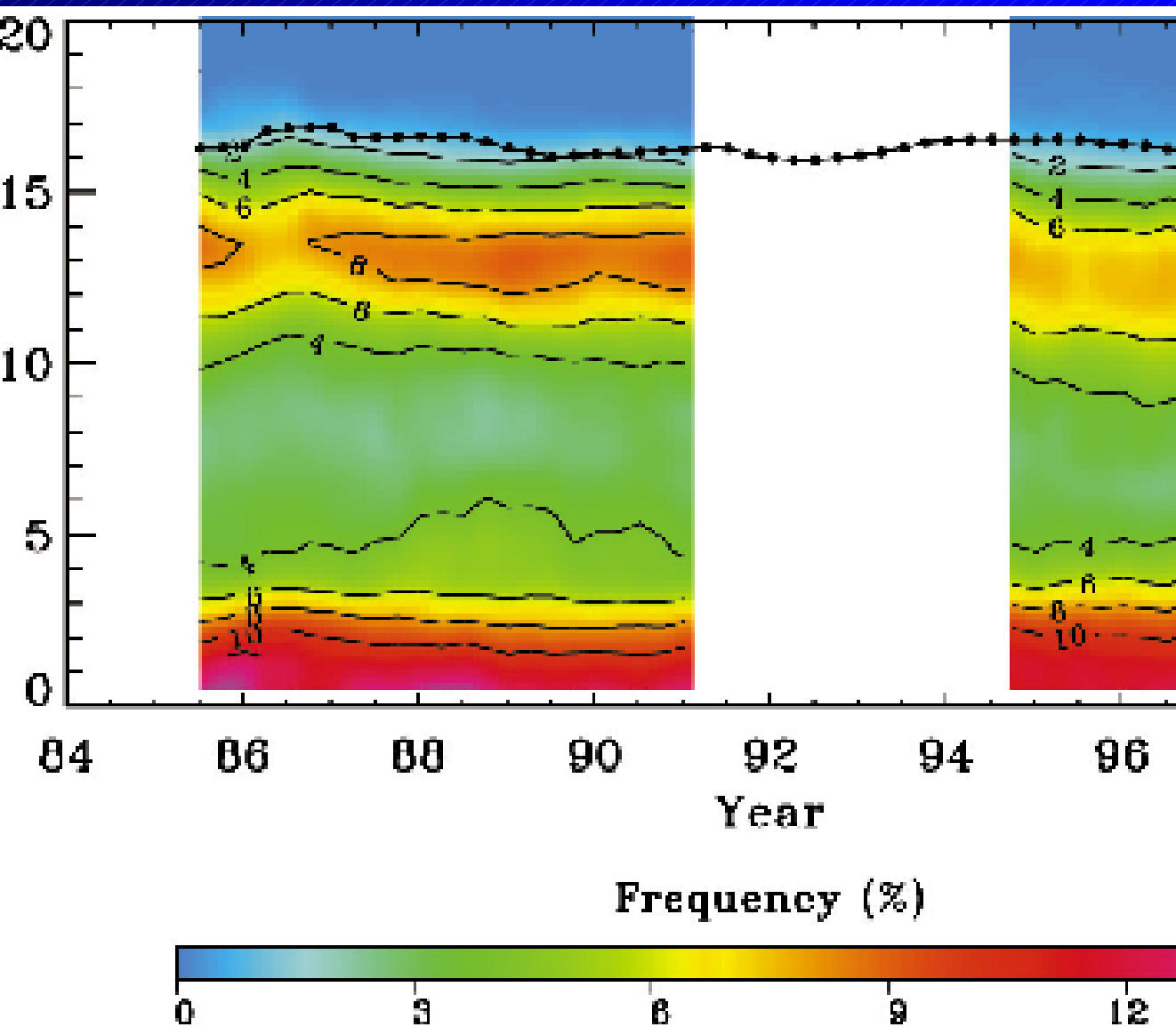
Annual Total Cloud Amount Change from 1985-89



UKMO: Tropical LW Flux Anomaly by LW Flux Percentile

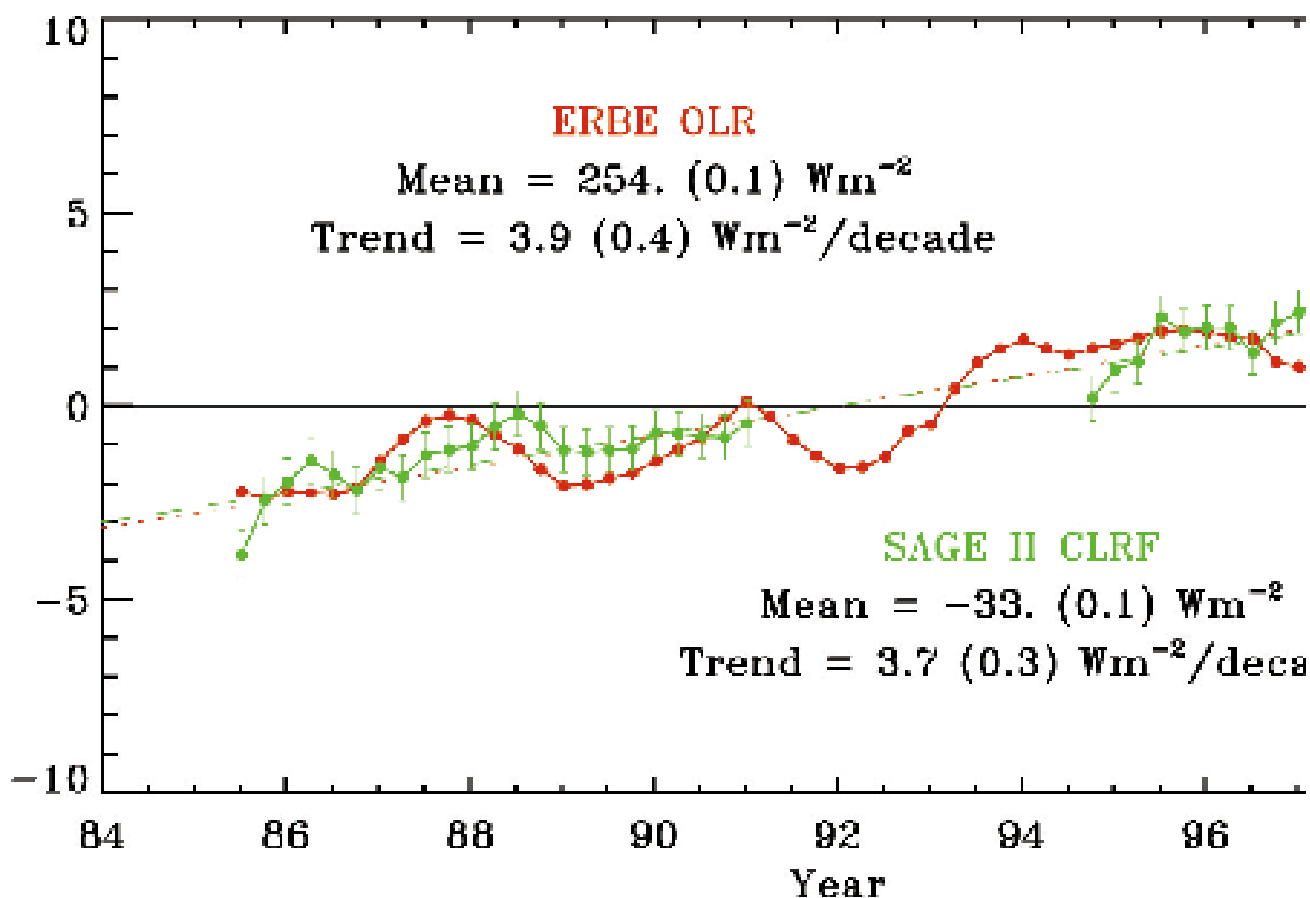


GE II Cloud Top Frequency Distribution: Reduced Cloud



Wang et al, GRL, 2001

**SAGE II Cloud Height Changes + Radiative Parameterization
only Explain 1/3 of ERBS LW flux anomaly: other 2/3 inferred to be
Cloud amount and/or emissivity changes (all 3 shown below)**



Wang et al., GRL 20

Summary:

- 1) No calibration problem yet explains decadal ERBS changes. Bob Lee et al. continuing to examine ERBS calibration.
 - 2) Seasonal changes in 90s tropical SW fluxes primarily aliasing of ERBS diurnal cycle into monthly means. Some increased 90s variability remains for both 36-day and 72-day precession cycle averages. Decadal changes now clearer.
 - 3) ISCCP, NCEP omega, Bates HIRS UTH roughly consistent but phasing, peaks, differ: do not expect simple linear relations between these variables. Further analysis needed.
- SAGE II cloud height decreases explain 1/3 of 3 W/m² LW change
- 5) Percentile tests show most changes in high LW flux, not low: downward branch of Hadley/Walker cells consistent with strengthened cells. Will redo this analysis to test gain change
 - 6) Surface observer clouds in 80s/90s show mixed bag: reduced warm pool cloud (high), and varying low cloud amounts